Evaluating a Temporal Behaviour for Web Browsers' Back and Forward Buttons

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ABSTRACT
This paper describes the evaluation of a 'temporal' alternative to the normal 'stack-based' behaviour of the Back and Forward buttons on web browsers. The main difference of the temporal scheme is that it maintains a complete list of previously visited pages. Results confirmed our prediction that the major limitation of the temporal system is in returning to parent pages. They also showed that the temporal scheme allowed many users to solve complex navigation tasks more efficiently than the stack system. Overall, the results are positive and indicate that the temporal scheme can be adapted to improve web navigation.

Keywords
Web navigation, World Wide Web, revisitation, browser design, hypertext.

INTRODUCTION
The 'Back' button accounts for up to 42% of user actions with web browsers [1,4], yet prior work has shown that users commonly misunderstand its stack-based behaviour [2]. The stack-based behaviour, used in all major commercial browsers, means that not all recently visited pages can be returned to with Back. To address this problem, Greenberg and Cockburn [3] proposed an alternative 'temporal' behaviour that removed the problems of missing pages by making a complete time-ordered list of previously visited pages (with duplicates removed) available with Back.

This paper describes an evaluation that compares the efficiency of the stack and temporal techniques. If results show that the temporal scheme allows more efficient navigation without detrimentally affecting subjective satisfaction, then the developers of commercial browsers should consider re-implementing Back and Forward.

EVALUATION METHOD
The evaluation was based around a series of realistic web-browsing tasks, with the participants using a 'new release of Netscape Navigator'. They were told that the new release 'may or may not have modified the behaviour of the Back and Forward buttons'.

The visual appearance, mouse bindings and response time of the stack-based and temporal interfaces were identical to those of Netscape Navigator version 4.72. Both interfaces were supported by overlaying unparented windows that provided exact visual replicas of the Back and Forward buttons over Netscape's actual Back and Forward buttons. When the subjects clicked the Back or Forward buttons our program modified the state of its stack or temporal list and issued appropriate page display requests to the browser. The subjects could pop-up Back/Forward menus that were visually indistinguishable from those normally produced by Netscape. The program logged all user actions and updated the state of the stack/temporal-list appropriately.

The thirty-four participants were all Computer Science students who used Netscape Navigator daily in their course work. Each evaluation lasted approximately one hour. Participants were randomly assigned to either the stack or the temporal interface. No training or instruction on the behaviour of the web browser was given.

The experiment consisted of repeating six tasks in three different web sites (one created specially for the experiment, one based on www.boeing.com, and one based on www.cs.waikato.ac.nz). Only two of the tasks are described in this paper: the *parent revisitation task* and the *cross-site distant revisitation task*. Full details of the experiment are provided at: www.cosc.canterbury.ac.nz/~andy/papers/back.pdf.

The *parent revisitation task* examined the subjects' ability to return to a parent (or home) page from a relatively deeply nested page. In the Boeing site the task was: "You are at the page describing the 747-international. Return to Boeing's Homepage." Users of both the stack and the temporal system could solve the task in a single action by selecting the homepage from the Back menu. However, if they solved the task by making discrete clicks on the Back button, the stack system would require three clicks while the temporal system would need either four or six (depending on earlier actions). We therefore predicted that the stack interface would be more efficient.

The *cross-site distant revisitation* task examined the subjects' ability to revisit a temporally distant page. An example of the task is: "You are at the page describing Boeing's 747-freighter commercial aircraft. Return to the Waikato University page 'Introduction to Computer Science' that you were at half an hour ago." In theory, the temporal system allows more efficient task completion than the stack-based system because only temporal users can directly select the page from the Back menu: in the stack-based system the page will have been removed from the menu by stack pruning [2]. Similarly, temporal users can complete the task by repeatedly clicking the Back button (but

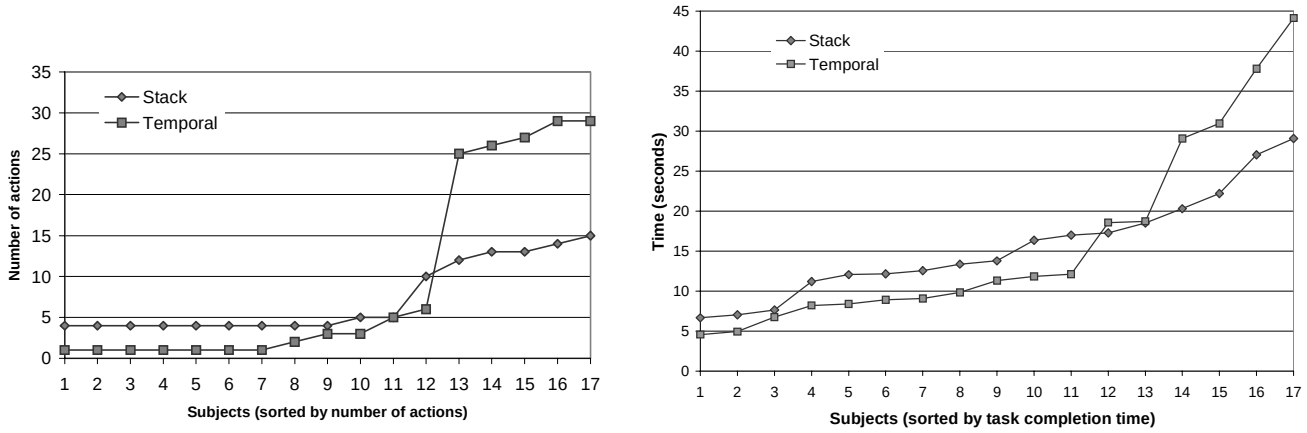

Figure 1: Number of actions and time taken to complete the cross-site distant revisitation task.

only after between 12 and 27 clicks), but no number of Back clicks will return to the page with the stack system. Users of the stack-system must switch from backtracking with Back to navigation using links. We were uncertain whether the participants in the experiment would benefit from the hypothetical advantages of the temporal system.

On completing each task, the subjects were asked to respond to two questions on a five-point Likert scale (1 disagree, 5 agree):

- I understood the browser's behaviour.
- The interface was efficient for the task.

RESULTS

In the *parent revisitation task*, the mean task completion times with the stack and temporal interfaces were 6.2 (σ 2.2) and 10.6 (σ 6.2) seconds, providing a significant difference: unpaired T-Test, $T(100)=4.81$, $p<.01$. Similarly, the mean action counts for the stack and temporal interfaces were significantly different at 2.4 (σ 1.3) and 4.1 (σ 2.8) actions: $T(100)=3.8$, $p<.01$. The superior performance of the stack-based system in this task is reflected in the participants' subjective assessment of efficiency, with mean responses of 4.55 (σ 0.9) and 3.57 (σ 1.6) for the stack and temporal interfaces (a significant difference, Mann-Whitney U Test, $p < .05$). The ratings for how well the subjects understood both interfaces were extremely high, with mean responses of 4.78 (σ 0.5) and 4.51 (σ 0.9) for the stack and temporal interfaces (no significant difference: $p=.13$).

Nineteen subjects (11 temporal, 8 stack) used the Back menu at some point during the parent revisitation task. The Back menu allowed the task to be completed with a single menu selection. Observations and comments from the subjects' indicated that the additional length of the menu in the temporal interface caused problems in searching for the desired page title. Several subjects mentioned the difficulty of 'finding the right page title among all the menu items' with both the stack and the temporal system.

The *cross-site distant revisitation task* provided an interesting contrast between the interfaces. The results revealed highly varied solution strategies in both interfaces. Although the overall means were similar for both interfaces, some users solved the task quickly, while others struggled. The mean solution times for the stack and temporal interfaces were 15.5 (σ 6.5) and 16.2 (σ 12.0) seconds, and the corresponding action counts were 7.2 (σ 4.4) and 8.4 (σ 8.9). Neither of these comparisons provides a statistically significant difference. Similarly, the subjective ratings for understanding and efficiency were not significantly differences.

The graphs in Figure 1 show the number of actions (left) and time (right) that the subjects (sort on the x-axes) took to complete the cross-site distant revisitation task. They show that most of the subjects using the temporal interface took fewer actions and less time than the stack users: seven solving the task with a single menu selection. The optimal stack solution (used by nine of the seventeen participants) took four actions. The figure also shows that five of the temporal users were particularly inefficient, taking twenty-five or more actions. The key factor in determining whether subjects performed efficiently or inefficiently with the temporal system was whether they used the Back-menu to access pages: those that did so were efficient. Had these subjects been aware of (or made use of) the Back-menu, we suspect their performance would have improved dramatically.

CONCLUSIONS

This paper described the evaluation of a temporal implementation of the Back and Forward buttons that maintains a complete list of visited pages. Results showed that although the temporal scheme was slower for returning to parent pages, most users were able to use it efficiently for returning to more distant pages. The results imply that a temporal list of pages can allow more rapid page revisitation *if* users access the appropriate interface control rather than simply clicking the back button many times. In further work we will develop and evaluate interfaces that improve access to temporal lists and which aid identification of the pages on them.

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